MATH 3631
Actuarial Mathematics II
Class Test 1 - 5:00-6:15 PM
Wednesday, 14 February 2018
Time Allowed: 1 hour
Total Marks: 100 points

Please write your name and student number at the spaces provided:

Name: _____   Student ID: _____

- There are ten (10) written-answer questions here and you are to answer all ten. Each question is worth 10 points.

- Please provide details of your workings in the appropriate spaces provided; partial points will be granted.

- Please write legibly.

- Anyone caught writing after time has expired will be given a mark of zero.

Question No. 1:

An insurer sells a portfolio of 702 fully discrete whole life insurance policies with death benefit of 1000 to lives with independent future lifetimes, each with age x. You are given:

- The annual contract premium is 16 per policy.

- $i = 0.04$ $A_x = 0.306$ $^2A_x = 0.113$

- A table of α-th percentile, z_α, from the standard normal distribution:

α	0.90	0.95	0.97	0.99
z_α	1.282	1.645	1.881	2.326

Calculate the probability of a gain from this portfolio of policies.

Question No. 2:

For a special whole life insurance on (45), you are given:

- Death benefit, payable at the end of the year of death, consists of 250 plus the return of all premiums without interest.

- Annual net premium of 5 is payable at the beginning of each year.

- $A_{45} = 0.25$ $\ddot{a}_{45} = 21.7$

Calculate $(IA)_{45}$.

Question No. 3:

For a whole life insurance issued to (40), you are given:

- The death benefit is 100, payable at the end of the year of death.

- There is only a single gross premium of 14, payable at policy issue.

- Initial expenses are 4% of the single gross premium.

- Additional expenses of 0.05 incurred at the beginning of each year, including the first policy year.

- Mortality follows the `Illustrative Life Table`.

- $\delta = 0.05$

- L_0 is the loss at issue for this policy.

Calculate $\Pr[L_0 > 15]$.

Question No. 4:

For a fully discrete whole life insurance of 100 on (40), you are given:

- First year expenses are 25% of the gross premium.

- Renewal expenses are 5% of the gross premium.

- Expenses are incurred at the beginning of the policy year.

- Gross premium is calculated according to the equivalence principle.

- Mortality follows the `Illustrative Life Table` with $i = 0.06$.

Calculate the gross premium reserve at the end of the second year.

Question No. 5:

For a fully discrete 10-year term insurance policy of 10 on (50), you are given:

- Mortality follows the `Illustrative Life Table`.

- $i = 0.06$

Calculate the net premium reserve at the end of 9 years.

Question No. 6:

For a fully discrete whole life insurance of 1 on (60), you are given:

- $q_{60} = 0.003 \qquad q_{61} = 0.004$

- $i = 0.05$

- $A_{60} = 0.30$

- $^2A_{60} = 0.10$

- L_t is the insurer's prospective loss at time t for this policy.

Calculate $\text{Var}(L_2)$.

Question No. 7:

For a fully discrete whole life insurance of 1,000,000 on (45), you are given:

- First year expenses are 20% of the gross premium plus 3000.

- Renewal expenses are 2% of the gross premium plus 300.

- All expenses are incurred at the beginning of the policy year.

- Gross premiums are calculated using the equivalence principle.

- Mortality follows the `Illustrative Life Table` with $i = 0.06$.

Calculate the gross premium reserve at the end of the first policy year.

Question No. 8:

For a life insurance policy issued to (x), you are given:

- Death benefit of 25,000 is payable at the end of the year of death.

- The annual net premium in year 16, payable at the beginning of the year, is 654.57.

- Deaths are assumed to be uniformly distributed over integral ages.

- $i = 0.05$ $_{15}V = 9,227.79$ $_{15.5}V = 9,889.50$

Calculate q_{x+15}.

Question No. 9:

For a 5-year endowment insurance on (60), you are given:

- The death benefit, payable at the end of the year of death, is equal to 1000 plus the benefit reserve.

- The endowment benefit is 4000.

- Level premiums, P, are payable annually at the beginning of each year.

- $q_{60+k} = 0.02$, for $k = 0, 1, 2, \ldots$

- $i = 0.05$

Calculate P.

Question No. 10:

For a fully discrete whole life insurance policy of 1 on (35), you are given:

- Mortality follows the `Illustrative Life Table`.

- $i = 0.06$

- Expenses consist of 5% of annual gross premium, payable at the beginning of each year.

- Both the annual net premium and the annual gross premium are determined according to the equivalence principle.

- $_tV^n$ and $_tV^g$ denote the net and gross premium reserves at time t, respectively.

Calculate $_{10}V^n - {}_{10}V^g$.

EXTRA PAGE FOR ADDITIONAL OR SCRATCH WORK